Niveau(x) d'enseignement : 4 Numéro EDUQ : 9070257
Centre d'intérêt : 755

Adiv, Ellen

Learning French through different core subjects : the effect of linguistic content on second language proficiency / E. Adiv & S. Walsh. -- [Montréal] : Commission des écoles protestantes du Grand Montréal, Instructional Services Department, 1981.
vi, 25 p. ; 28 cm.

Titre de la couv. Résumé en français et en anglais. p. ii-v. Bibliogr. : p. 17. Notes bibliogr. : p. 16.

Vedette(s)-secondaire(s) : Walsh, S. ▪ Commission des écoles protestantes du Grand Montréal. Instructional Services Department.

Descripteur(s) : Français (Langue) ▪ Langue seconde ▪ Classe d'immersion ▪ Environnement linguistique ▪ Habileté de communication ▪ Secondaire (Ordre d'enseignement)

Cette étude avait pour but d'évaluer le développement de la compétence linguistique des élèves étudiant différentes matières en français au programme de post-immersion. On supposait que l'histoire et la géographie fourniraient plus d'occasions de communiquer que la biologie et les mathématiques, que le contenu linguistique de ces dernières était moins riche. Les résultats mènent à conclure que le développement de la compétence linguistique en français ne semble pas être directement relié au contenu linguistique des diverses matières enseignées.

Type de document : r

9070257

# LEARNING FRENCH THROUGH DIFFERENT CORE SUBJECTS: THE EFFECT OF LINGUISTIC CONTENT ON SECOND LANGUAGE PROFICIENCY

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September 1981

## Acknowledgements

This research was made possible by a research grant to the Instructional Services Department, The Protestant School Board of Greater Montreal, from le Ministère de l'Education, Gouvernement du Québec.

We would like to thank the principals, French Department heads, teachers and students who participated in this research for their assistance. We would also like to express our gratitude to Mr. Aziza, French consultant at the P.S.B.G.M., for his assistance. A special note of thanks is due to the French control school of la Commission scolaire Jérôme Le Royer for its most generous participation in the project.

Résumé

Le but de cette étude était d'évaluer le développement de la compétence linguistique des élèves étudiant différentes matières en français au programme de post-immersion. Cinq groupes d'élèves de 10e année ont participé à cette étude: un groupe d'élèves en histoire, un groupe d'élèves en géographie, un groupe d'élèves en biologie et deux groupes d'élèves en mathématiques (math I et math II). Un groupe témoin français a été inclus pour fins de comparaison.

La compétence linguistique en français a été évaluée en administrant les tests suivants: un test de vocabulaire contenant quatre sous-tests et trois tests de lecture cloze. Les tests contenaient des items se rapportant spécifiquement aux matières étudiées dans les divers cours et des items se rapportant à des connaissances linguistiques plus générales. Chaque test a été administré deux fois: une fois au début de l'année scolaire (pré-test) et une fois à la fin de la même année scolaire (post-test).

Les résultats indiquent: (1) pour tous les groupes, les résultats obtenus aux post-tests étaient nettement supérieurs à ceux obtenus aux pré-tests; (2) il n'y avait que peu de différences significatives entre le groupe d'élèves en histoire et le groupe d'élèves en math I; (3) il n'y avait presque pas de différences significatives entre le groupe d'élèves en géographie et le groupe d'élèves en math II; (4) les résultats des groupes d'élèves respectivement en histoire et en math I étaient

toujours supérieurs à ceux des groupes d'élèves respectivement en géographie et en math II; le groupe d'élèves en biologie se situait entre les groupes d'élèves en histoire et en math I d'un côté, et les groupes d'élèves en géographie et en math II de l'autre; (5) dans plusieurs tests il n'y avait pas de différences significatives entre les résultats des élèves en histoire et en math I et ceux du groupe témoin francophone.

Les résultats de cette étude nous mènent à conclure que le développement de la compétence linguistique en français ne semble pas être directement relié au contenu linguistique des diverses matières enseignées.

## Summary

The purpose of this study was to assess the development of French proficiency of students studying different French core subjects such as History and Geography at the post-immersion level. Five different groups of grade 10 students participated in the study: one History group, one Geography group, one Biology group and two Mathematic groups (Math I and Math II). A French control group was included for comparison purposes.

French linguistic proficiency was measured by the following test battery: a vocabulary test containing four sub-tests and a set of three "cloze" reading tests. The tests contained items relevant to each of the core subject areas and items pertaining to more general linguistic knowledge. Each test was administered twice, once at the beginning of the school year and once at the end of that same school year.

The results indicate that: (1) there was significant improvement between the pre-test and post-test scores of all five groups; (2) there were only few significant differences between the History group and the Math I group; (3) there were practically no significant differences between the Geography group and the Math II group; (4) the History and Math I groups ranked consistently higher than the Geography and Math II groups and the Biology group ranked between these two groupings; (5) on several tests there were no significant differences between the scores of the History and Math I groups and those of the French controls.

The findings of this study lead to the conclusion that the development of French proficiency does not seem to be directly correlated with the linguistic content of the various core subject.

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Over the past decade a number of evaluations have been carried out by the P.S.B.G.M.'s Research department to assess the level of French proficiency achieved by students attending the different immersion and post-immersion programs offered by this Board (Adiv and Morcos, Note 1; Adiv and Walsh, Note 2; Genesee, Note 3; Genesee and Leblanc, Note 4; Genesee and Morcos, Note 5). The most noteworthy findings of these evaluations were: (1) The immersion students scored significantly higher on French language tests than students receiving the regular 50 minutes-a-day of French language instruction. (2) Students attending the more intensive immersion programs (early immersion and two-year late immersion) seemed to develop native-like competence in the receptive skills in French (oral and written comprehension), but not in the productive skills. (3) Differences between students attending these programs and those attending the less intensive one-year late immersion program were not consistent and tended to decrease as the students progressed through the grades. On the basis of these findings it was implied that the follow-up program may be insufficient to provide maximal linguistic development for each type of immersion program.

One of the issues that has concerned educators and researchers involved in immersion programs is the contribution of core subjects such as History and Geography to the development of second language proficiency. On the one hand, it has been argued that language is learned best when the material to be learned is of inherent interest to the learner (Tucker & d'Anglejan, 1976). Thus if Mathematics and Science courses are more

relevant to students than History or Geography courses, then such courses may provide the learner with a viable opportunity to expand his competence in the second language. On the other hand, teachers and those involved in the development of second language programs seem to feel that content courses related to the humanities (e.g. History and Geography) are more likely to promote maximal linguistic growth because of the more varied linguistic experience which they provide (Aziza, personal communication).

It is with these issues in mind that the present study was undertaken. More precisely, the study addressed itself to the following questions: (1) Over the course of a school year, does overall performance in the second language improve equally when students take different core subjects in French? (2) Is the level of French proficiency attained by students taking History and Geography courses higher than that attained by students taking Mathematics and Biology courses?

## Method

### The Samples

Selection of the students was based on the core subject (Biology, Geography, History, Mathematics) which these students were taking in French as part of the post-immersion program. In all, six groups of grade 10 students participated in this study: a Biology group, a Geography group, a History group, two Mathematic groups (hereafter Math I group and Math II group) and a French control group. A summary of the actual sample sizes is presented in Table 1A, and a list of the schools from which these

samples were selected is presented in Table 18.

In order to assess the equivalence of the groups in terms of mental ability, all the students were administered the Raven's Standard Progressive Matrices test. This is a non-verbal test and is, therefore, particularly suitable for testing second language learners who speak different native tongues.

The Test Battery

The following French language tests were administered: a "test de vocabulaire" and a "test de lecture cloze". Each test is described briefly below.

(1) Test de vocabulaire

This multiple-choice test was developed by the Research department of the P.S.B.G.M. for the present evaluation. It consists of 38 vocabulary items chosen so as to reflect the basic vocabulary in each subject area. The test is divided into two parts. The first part contains 20 items (10 taken from Mathematics and 10 taken from Biology). The student has to associate each item with a related concept. In each case four alternatives are given. The second part contains 18 items (10 taken from Geography and 8 taken from History). Here, for each item, the student has to choose the best definition out of four alternatives. The student's score consisted of his or her total number of correct responses.

(2) Test de lecture cloze

The cloze test has been used extensively as a measurement of overall proficiency in second language achievement (Aitken 1977; Oller, 1973).

The most common version consists of a passage from which every n-th word has been deleted. The student must complete the passage by supplying replacements for the deleted words.

Three cloze tests were developed for the present study. Since the purpose of the study was to measure language gains in specific areas of French competence, the words were not deleted randomly but rather on basis of their semantic content as in sub-tests I and II below or on basis of their grammatical function as in sub-test III below.

Sub-test I of the test de lecture cloze consists of a 175-word passage taken from a Geography textbook and is entitled "Le Québec". The passage contains a total of 21 deletions. Sub-test II is a 190-word passage taken from a History textbook and is entitled "Le Canada et les Etats-Unis". The passage contains a total of 19 deletions. Neither of these textbooks were being used in the classroom. Sub-test III consists of a 272-word passage taken from a magazine article and is entitled "Seule dans le désert". The passage contains a total of 30 deletions.

The tests were scored in two different ways: exact word replacements and contextually acceptable word replacements. In the latter case spelling mistakes were not considered. The evaluation of the acceptable word replacements was based on the independent judgment of two native French-speaking judges. The judges' ratings were combined to form a single score for each student.

Testing procedures

All the tests were administered twice to the same students,

once at the beginning of the school year (October 1980) and once at the end of the school year (April 1981). The tests were group administered to intact classes in each subject area. Results of students with French-speaking parents were excluded from the data analysis. Each test was administered during a 50-minute period and the two tests were never given on the same day. The French control group could only be pre-tested in November. In consequence, these students were not retested in April since it was felt that there would be no substantial gains in the linguistic competence of native speakers over so short a period.

## Results

The students' scores on the Raven's Standard Progressive Matrices test were analyzed first using an analysis of variance procedure. The results of this analysis revealed that there were statistically significant differences among the groups (Table 2). Since these differences could influence the results of the French language tests and thus confound the effect of the different core subjects, all French language tests were analyzed using an analysis of covariance procedure (see the appendix for a brief explanation). In the analysis of the linguistic data, two different statistical procedures were used. First, in order to assess the progress made by each post-immersion group during the school year, a two-way analysis of covariance with repeated measures was performed. Here the pre- and post-test scores obtained for each group were used. Second, a one-way analysis of covariance was performed to compare the post-test scores of each group to those of the French control group. Wherever the statistical

analyses revealed significant between-group differences, Tukey's procedure of post-hoc multiple comparisons was used to determine which groups differed significantly from one another. All the test scores and the results of the statistical analyses are summarized in Tables 3, 4, 5 and 6. For each test the mean scores shown in the tables represent mean scores adjusted for group differences on the Standard Progressive Matrices test scores. To simplify data presentation, two formats have been used to represent between-group comparisons. When there are fewer significant differences than insignificant differences, the significant ones have been indicated by a solid line in the tables; where there are fewer insignificant differences, these have been indicated by a broken line. The results of the analyses will be discussed below. The results of the comparison between the pre- and post-test scores will be presented first (see Tables 3 and 4), followed by the comparison with the French controls (see Tables 5 and 6).

Comparison of Pre- and Post-Test Results

(1) Test de vocabulaire

The results of the test de vocabulaire indicate that there was a significant improvement in performance between the pre- and post-test scores ($F = 72.00$, $p < .001$). Moreover, there were significant differences between the groups ($F = 7.14$, $p < .01$). The History group (pre-test $\bar{X} = 17.20$, post-test $\bar{X} = 20.89$) the Math I group (pre-test $\bar{X} = 16.76$,

post-test $\bar{X}$ = 20.37) and the Biology group (pre-test $\bar{X}$ = 16.67, post-test $\bar{X}$ = 21.12) scored significantly higher than the Math II group (pre-test $\bar{X}$ = 12.52, post-test $\bar{X}$ = 14.52). The History and Biology groups also scored significantly higher than the Geography group (pre-test $\bar{X}$ = 13.77, post-test $\bar{X}$ = 15.91). Since there was no significant group x test interaction, this ranking of the groups is applicable to both the pre-test and the post-test results.

On sub-test I of the test de vocabulaire which tested the students' knowledge of mathematical terms, there was again a significant improvement in performance between the pre-and post-test scores ($F$ = 9.93, $p < .001$). Here the Math I group scored numerically higher than any of the other groups both on the pre-test ($\bar{X}$ = 5.18) and on the post-test ($\bar{X}$ = 6.18). Statistically, the Math I group scored significantly higher than the Biology group (pre-test $\bar{X}$ = 3.62, post-test $\bar{X}$ = 4.51), the Geography group (pre-test $\bar{X}$ = 3.56, post-test $\bar{X}$ = 3.49) and the Math II group (pre-test $\bar{X}$ = 3.63, post-test $\bar{X}$ = 4.50).

The results for sub-test II which tested the studunts' knowledge of terms related to Biology also indicate a significant improvement between pre-and post-test scores ($F$ = 46.85, $p < .001$). Here the Biology group made the biggest gains (pre-test $\bar{X}$ = 3.71, post-test $\bar{X}$ = 7.26). However, the only significant between-group differences were between the Biology group and both the Geography group (pre-test $\bar{X}$ = 3.21, post-test $\bar{X}$ = 3.41) and the Math II group (pre-test $\bar{X}$ = 2.77, post-test $\bar{X}$ = 3.90).

Sub-test III of the test de vocabulaire which assessed the students' knowledge of terms related to Geography was the only vocabulary sub-test on which there was no significant difference between the pre- and post-test scores. However, there were significant differences between the groups ($F = 5.13$, $p < .01$). The History group (pre-test $\bar{X} = 5.18$, post-test $\bar{X} = 5.43$) scored significantly higher than the Geography group (pre-test $\bar{X} = 3.44$, post-test $\bar{X} = 4.04$) and the Math II group (pre-test $\bar{X} = 3.05$, post-test $\bar{X} = 3.36$). The Biology group (pre-test $\bar{X} = 4.92$, post-test $\bar{X} = 4.87$) also scored significantly higher than the Math II group. There were no other significant differences.

On sub-test IV of the test de vocabulaire which tested knowledge of lexical items associated with History there was, once again, a significant improvement in performance between the pre- and post-test scores ($F = 15.85$, $p < .01$). There were also significant differences between groups. However, there was a group x test interaction ($F = 3.66$, $p < .01$) indicating that improvement was not uniform for all the groups. On this sub-test, the History group (pre-test $\bar{X} = 3.94$, post-test $\bar{X} = 5.75$) made the biggest gains. Moreover, the latter group, the Math I group (pre-test $\bar{X} = 3.95$, post-test $\bar{X} = 5.34$) and the Biology group (pre-test $\bar{X} = 4.41$, post-test $\bar{X} = 4.46$) scored significantly higher than the Geography group (pre-test $\bar{X} = 3.56$, post-test $\bar{X} = 4.96$) and the Math II group (pre-test $\bar{X} = 3.07$, post-test $\bar{X} = 2.76$). It is noteworthy that the post-test scores of the Math II group were lower here than the pre-test scores.

(2) Test de lecture cloze

The results for the exact word replacements on the test de lecture cloze (total score) indicate that there was a significant improvement in performance between the pre-test and post-test results for all the groups ($F = 41.69$, $p < .01$). Moreover, there were significant between-group differences ($F = 5.08$, $p < .01$). The History group (pre-test $\bar{X} = 23.42$, post-test $\bar{X} = 26.29$) scored significantly higher than the Geography group (pre-test $\bar{X} = 14.81$, post-test $\bar{X} = 19.54$) and the Math II group (pre-test $\bar{X} = 12.30$, post-test $\bar{X} = 14.05$). There were no other significant differences between the groups.

On sub-test I of the test de lecture cloze which was an excerpt of a Geography text, there was again a significant improvement between pre-test and post-test scores ($F = 10.92$, $p < .01$) for all groups except the History group (pre-test $\bar{X} = 7.79$, post-test $\bar{X} = 7.73$). However, the overall test scores of the History group were significantly higher than those of the Math I group (pre-test $\bar{X} = 4.22$, post-test $\bar{X} = 5.99$), the Biology group (pre-test $\bar{X} = 4.81$, post-test $\bar{X} = 5.42$) and the Math II group (pre-test $\bar{X} = 3.79$, post-test $\bar{X} = 4.16$). There were no significant differences on this test between the History group and the Geography group (pre-test $\bar{X} = 5.82$, post-test $\bar{X} = 6.89$). The latter group also scored significantly higher th[illegible]e Math II group.

On sub-test II, which was an excerpt of a History text, the History group (pre-test $\bar{X} = 4.02$, post-test $\bar{X} = 5.02$) scored significantly higher than the Biology group (pre-test $\bar{X} = 2.15$, post-test $\bar{X} = 3.04$), the Geography group (pre-test $\bar{X} = 2.28$, post-test $\bar{X} = 3.28$), and the Math II

group (pre-test $\bar{X}$ = 1.96, post-test $\bar{X}$= 2.15). There were no other significant between-group differences on this sub-test. However, improvement between pre-test and post-test scores was significant for all the groups ($F \geq 12.13$, $p < .01$).

The results for sub-test III of the test de lecture cloze, which assessed the students' knowledge of French grammar, showed again significant improvement between pre-test and post-test scores ($F \geq 25.28$, $p < .01$), with few significant between-group differences. The History group (pre-test $\bar{X}$ = 11.60, post-test $\bar{X}$ = 13.53) scored significantly higher than the Geography group (pre-test $\bar{X}$= 6.72, post-test $\bar{X}$= 9.38) and the Math II group (pre-test $\bar{X}$ = 6.56, post-test $\bar{X}$= 7.75).

The pattern of the acceptable word replacements scores is similar to that of the exact replacements scores. For both the total score and the sub-test scores, there was significant improvement between pre-test and post-test scores for all the groups. As expected, for all the groups the results on the acceptable word replacements scores were higher than those of the exact word replacements. This difference accentuated the superior performance of the History group which ranked significantly higher than all the other groups on the total scores and on sub-test I (for details see Table 4).

Comparison of Post-Test Results with French Controls

(1) Test de vocabulaire

The results of the test de vocabulaire (total score) indicate that the French controls ($\bar{X}$ = 25.04) scored significantly higher than all

the other groups. Moreover, the History group ($\bar{X}$ = 20.40), the Math I group ($\bar{X}$ = 20.20) and the Biology group ($\bar{X}$ = 20.71) scored significantly higher than the Geography group ($\bar{X}$ = 15.72) and the Math II group ($\bar{X}$ = 14.51).

However, the between-group differences differed considerably on the various sub-tests. On sub-test I (Math vocabulary) the French controls ($\bar{X}$ = 5.96) did not score significantly higher than the History group ($\bar{X}$ = 4.74). There were also no significant differences between the French controls and the Math I group ($\bar{X}$ = 6.20). Moreover, these three groups (French control, History and Math I) scored significantly higher than the Biology group ($\bar{X}$ = 4.23), the Geography group ($\bar{X}$ = 3.46) and the Math II group ($\bar{X}$ = 4.49).

On sub-test II (Biology vocabulary) the Biology group ($\bar{X}$ = 7.13) scored significantly higher than all the other groups. The French controls ($\bar{X}$ = 5.15), the History group ($\bar{X}$ = 4.74) and the Math I group ($\bar{X}$ = 5.08) also scored significantly higher than the Geography group ($\bar{X}$ = 3.39).

On sub-test III (Geography vocabulary) the French controls ($\bar{X}$ = 7.74) scored significantly higher than all the other groups. Furthermore the History group ($\bar{X}$ = 5.20) and the Biology group ($\bar{X}$ = 4.87) scored significantly higher than the Math II group ($\bar{X}$ = 3.41). There were no other significant differences.

On sub-test IV (History vocabulary) the Math II group ($\bar{X}$ = 2.72) scored significantly lower than all the other groups. The Biology group ($\bar{X}$ = 4.48) also scored significantly lower than the French controls ($\bar{X}$ = 6.15). There were no significant differences between the latter group, the History

group ($\bar{X}$ = 5.74) and the Math I group ($\bar{X}$ = 5.36).

(2) Test de lecture cloze

The results for the test de lecture cloze (exact word replacements) indicate significant between-group differences on the total score and on all the sub-test scores. On the total score, there was a significant difference between the French controls ($\bar{X}$ = 31.28) and all the other groups except the History group ($\bar{X}$ = 25.15). The latter group also scored significantly higher than the Math II group ($\bar{X}$ = 13.60). There were no other significant differences.

The above pattern was maintained throughout the three sub-tests. However, on sub-test I, there was also a significant difference between the Geography group ($\bar{X}$ = 6.72) and the Math II group ($\bar{X}$ = 4.00) (for details see Table 6).

The results for the acceptable word replacements show fewer significant differences between the French controls and the other groups on the total score and on sub-test II. Moreover, on sub-test I, the differences between the French controls and the Math I, Biology and Geography groups are only marginally significant (for details see Table 6).

## Summary and Discussion

The results of this study can be summarized as follows:

(1) For all the groups there was significant improvement between the pre- and post-test scores on the various tests.

(2) There were no significant differences between the History and the

Math I group except on the total score of the acceptable word replacements of the test de lecture cloze and on sub-test I (Geography) of the same test. On these tests the History group scored significantly higher than the Math I group.

(3) There were no significant differences between the Geography and the Math II groups on any of the tests except on sub-test I of the test de lecture cloze (exact word replacements). Here the Geography group scored significantly higher than the Math II group.

(4) On practically all the tests, the Biology group ranked higher than the Geography and Math II groups but lower than the History and Math I groups. However, in its own subject area this group scored significantly higher than all the other groups.

(5) There were no significant differences between the History group and the French controls on the test de lecture cloze (exact and acceptable word replacements). Similarly there were no significant differences between these two groups on sub-tests I, II and IV of the test de vocabulaire.

(6) There were no significant differences between the Math I group and the French controls on the total score and on sub-test II of the test de lecture cloze (acceptable word replacements). Similarly there were no significant differences between these two groups on any of the test scores of the test de vocabulaire, except for sub-test III.

Several noteworthy findings emerge from these results. First, two major groupings can be identified here: the History and the Math I group on the one hand and the Geography and Math II groups on the other. Second, the History and Math I groups demonstrated consistently a higher level of proficiency than the Geography and Math II groups. Third, the Biology group ranked between these two groupings. Fourth, this rank order was maintained throughout both testing times (pre- and post-tests) indicating that the various groups made similar linguistic gains during this period. Sixth, each of the three higher ranking groups (History, Math I and Biology) tended to perform better than the other groups on the vocabulary sub-tests related to their own subject area ( in fact the Biology group scored significantly higher than the History group, Math I group and even the French controls on the Biology sub-test of the test de vocabulaire). On the other hand, the Geography and Math II groups failed to obtain comparatively higher test scores in their respective subject areas.

These findings suggest that the level of proficiency achieved in French may not be directly associated with the linguistic content of the various core subjects examined in this study. This conclusion seems further supported by the finding that student performance on all tasks improved significantly between the pre-tests and the post-tests. Thus the fact that students have to function in French, regardless of the subject matter, seems to contribute to an increase in their overall knowledge in the second language.

In accepting these conclusions, it must, of course, be borne

in mind that these findings are based on the results of a limited sample of students. Individual student characteristics such as their linguistic, ethnic and socio-economic backgrounds, as well as teacher effect may influence the level of performance. Some of these variables have been noted to affect French performance in certain immersion programs (see Adiv and Walsh Note 2). Such factors could also explain the difference in performance noted here between the Math I and Math II groups since these groups came from two schools situated in geographically distinct areas of Montreal, whereas the Math I group and the History group came from the same school. Unfortunately the number of P.S.B.G.M. schools offering Mathematic and Biology courses in French at the post-immersion level (all grade 10 classes offering these courses were included in this study) did not allow for control of these variables. Testing over a number of years would seem advisable to make the findings of this study more generalizable.

Nevertheless the present findings seem to suggest that there is no reason to restrict post-immersion content courses to subjects such as History and Geography which are presumed to be linguistically richer. In view of the importance that students attach to subjects such as Mathematics and Biology (see Adiv, Note 6) it may, in fact, be important to continue to offer, whenever possible, such courses in French so as to encourage post-immersion students to remain in the program throughout secondary school.

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Table I

(A) Sample Sizes

| | |
|---|---|
| History group | 19 |
| Math I group | 20 |
| Biology group | 20 |
| Geography group | 15 |
| Math II group | 18 |
| French control group | 22 |

(B) Participating Schools

| | | | |
|---|---|---|---|
| Lachine High | Riverdale High | Verdun High | La Commission scolaire Jérôme Le Royer |

Table 2

...ry of Results from the Raven's Standard Matrices Test[a]

| | Mean | Range |
|---|---|---|
| History group | 54.32 | 47 - 59 |
| Math I group | 53.70 | 45 - 60 |
| Biology group | 50.59 | 43 - 58 |
| Geography group | 51.73 | 42 - 58 |
| Math II group | 50.61 | 44 - 57 |
| French controls | 48.18 | 33 - 56 |
| F ratio: | 4.66** | |
| df : | 5,110 | |

** $p < .01$

[a]Maximum score: 60

Table 3

Summary of Pre- and Post-Test Results for the "Test on Vocabulary"[a]

| | History | | Math I | | Biology | | Geography | | Math II | | F ratio | F ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre-T | Post-T | Pre-T | Post-T | Pre-T | Post-T | Pre-T | Post-T | Pre-T | Post-T | Pre-Post | group |
| Total (38)[b] | 17.20 | 20.89 | 18.76 | 20.37 | 16.67 | 21.12 | 13.72 | 15.99 | 12.92 | 18.92 | 72.00*** | 7.14** |
| Subtest I (10) (Math) | 4.26 | 4.89 | 5.18 | 6.18 | 3.62 | 4.51 | 3.56 | 3.49 | 3.63 | 4.50 | 9.91*** | 7.25** |
| Subtest II (10) (Biology) | 3.84 | 4.88 | 3.97 | 5.33 | 3.71 | 7.26 | 3.29 | 3.41 | 2.77 | 3.90 | 66.85*** | 9.32** |
| Subtest III (10) (Geography) | 5.18 | 5.43 | 3.67 | 4.03 | 4.92 | 4.87 | 3.44 | 4.04 | 3.05 | 3.36 | 1.92 | 5.13** |
| Subtest IV (8) (History) | 3.94 | 5.75 | 3.95 | 5.34 | 4.43 | 4.46 | 3.56 | 4.96 | 3.07 | 7.76 | 15.65** | 3.01** |

** $p < .01$

*** $p < .001$

[a] Mean scores joined by a solid line differ significantly from one another.
Mean scores joined by a broken line do not differ significantly from one another.

[b] Maximum possible scores are indicated in parentheses.

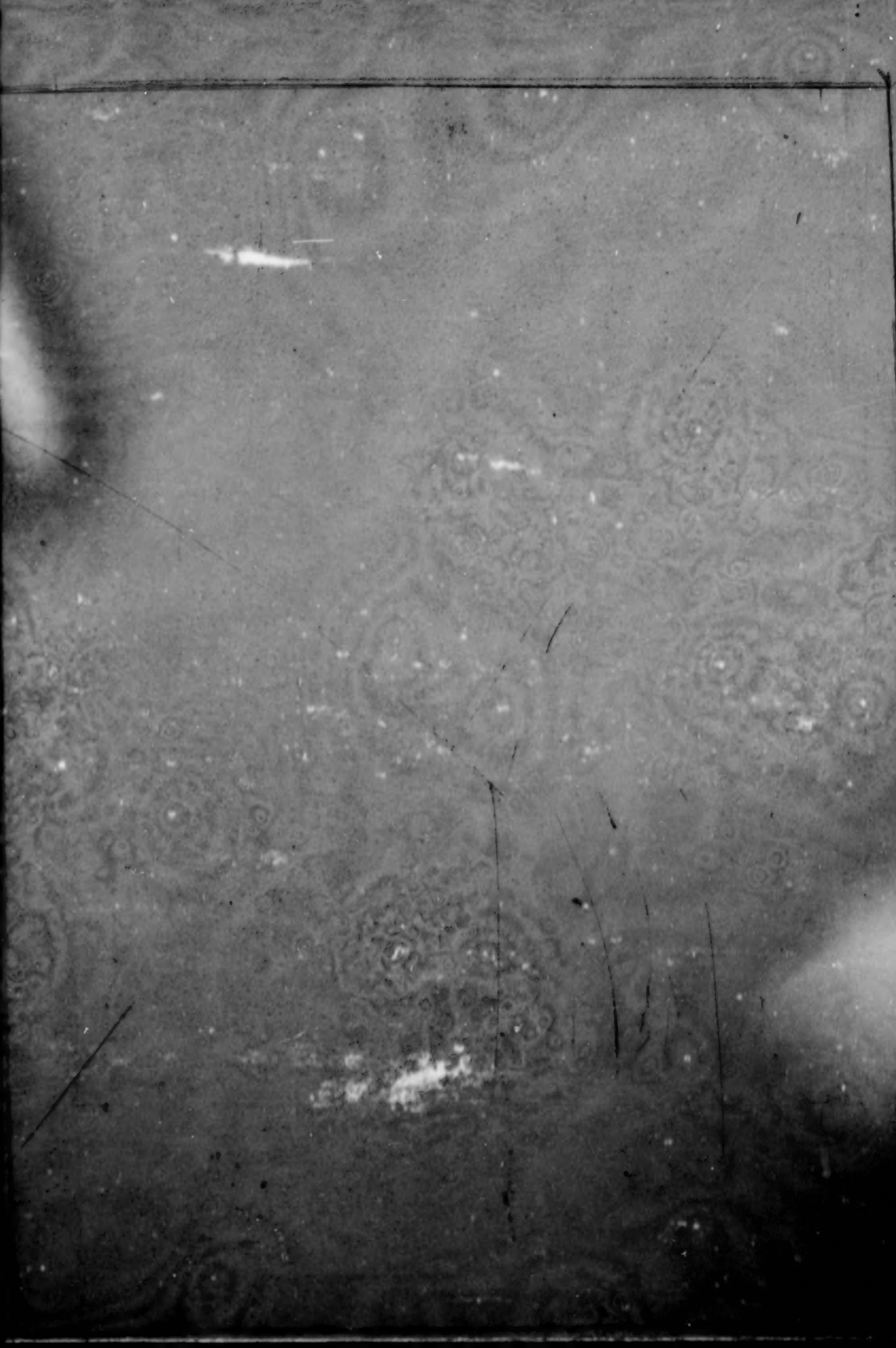

Table 4

Summary of Pre- and Post-Test Results for the "Test do lecture Cloze"[a]

| | History | | Math I | | Biology | | Geography | | Math II | | F ratio | ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre-T | Post-T | Pre-T | Post-T | Pre-T | Post-T | Pre-T | Post-T | Pre-T | Post-T | Pre - Post | Groups |
| Exact Replacements | | | | | | | | | | | | |
| Total (70)[b] | 23.42 | 26.29 | 16.45 | 20.95 | 17.01 | 18.96 | 14.01 | 19.54 | 12.30 | 14.05 | 41.69** | 5.08** |
| Subtest I (21) (Geography) | 7.79 | 7.73 | 4.22 | 5.99 | 4.81 | 5.42 | 5.82 | 6.89 | 3.79 | 4.16 | 10.92** | 7.11** |
| Subtest II (19) (History) | 4.82 | 7.02 | 3.19 | 4.68 | 2.15 | 3.06 | 2.28 | 3.28 | 1.96 | 2.15 | 12.13** | 8.91** |
| Subtest III (30) (Grammar) | 11.60 | 13.53 | 9.04 | 11.04 | 10.06 | 10.51 | 6.72 | 9.38 | 6.56 | 7.75 | 25.[illegible]** | 3.64** |
| Acceptable Replacements | | | | | | | | | | | | |
| Total (70) | 33.55 | 35.92 | 23.35 | 29.96 | 23.56 | 28.73 | 19.51 | 26.64 | 11.92 | 20.89 | 5.16** | 8.69** |
| Subtest I (21) (Geography) | 13.06 | 12.35 | 8.66 | 10.49 | 8.04 | 9.01 | 8.42 | 10.32 | 7.35 | 7.51 | 5.56** | 8.69** |
| Subtest II (19) (History) | 6.79 | 7.85 | 4.90 | 5.95 | 3.73 | 6.01 | 3.14 | 4.69 | 2.06 | 3.52 | 19.89** | 8.51** |
| Subtest III (30) (Grammar) | 14.68 | 15.35 | 10.52 | 13.11 | 11.53 | 12.86 | 7.89 | 11.42 | 7.30 | 9.75 | 88.58** | 8.75** |

[a]Mean scores joined by a solid line differ significantly from one another

[b]Maximum scores are indicated in parentheses

** $p < .01$

*** $p < .001$

Table 5

Comparison of Post-Test Results and French Control Scores on the "Test de vocabulaire"

| | French Control | History Group | Math I Group | Biology Group | Geography Group | Math II Group | |
|---|---|---|---|---|---|---|---|
| Total (30)[b] | 25.00 | 20.40 | 20.20 | 20.71 | 15.72 | 14.53 | 11.65*** |
| Subtest I Math (10) | 5.98 | 4.74 | 5.20 | 4.23 | 3.46 | 4.09 | 7.47*** |
| Subtest II Biology (10) | 5.15 | 4.74 | 5.60 | 7.13 | 2.39 | 3.98 | 10.92*** |
| Subtest III Geography (10) | 7.74 | 5.20 | 3.85 | 4.87 | 3.98 | 3.43 | 18.20 |
| Subtest IV History (8) | 6.35 | 5.74 | 5.35 | 4.48 | 4.92 | 2.72 | 8.28 |

*** $p < .001$

[a] Mean scores joined by a solid line differ significantly from one another.

Mean scores joined by a broken line do not differ significantly from one another.

[b] Maximum possible scores are indicated in parentheses.

Table 6

Comparison of Post-Test Results and French control scores for the "Test de Lecture Cloze"[a]

| | French Control | History Group | Math I Group | Biology Group | Geography Group | Math II Group | F Ratio |
|---|---|---|---|---|---|---|---|
| Exact Replacements | | | | | | | |
| Total (70)[b] | 10.20 | 25.15 | 20.18 | 19.33 | 19.22 | 13.60 | 12.26*** |
| Subtest I Geography (21) | 8.65 | 7.39 | 5.69 | 5.68 | 6.72 | 4.00 | 6.94*** |
| Subtest II History (19) | 5.90 | 4.75 | 3.98 | 3.71 | 3.24 | 2.15 | 7.45*** |
| Subtest III Grammar (30) | 16.91 | 12.99 | 10.70 | 10.44 | 9.26 | 7.45 | 10.31*** |
| Acceptable Replacements | | | | | | | |
| Total (70) | 39.75 | 34.66 | 25.13 | 29.15 | 26.12 | 20.25 | 11.47*** |
| Subtest I Geography (21) | 13.09 | 11.67 | 10.13 | 10.06 | 10.14 | 7.20 | 6.66*** |
| Subtest II History (19) | 8.20 | 7.80 | 5.16 | 6.20 | 8.63 | 3.86 | 6.04*** |

Table 5 (continued)

Comparison of Post-Test Results and French control scores for the "Test de Lecture Clore"[a]

| | French Control | History Group | Math I Group | Biology Group | Geography Group | Math II Group | F Ratio |
|---|---|---|---|---|---|---|---|
| Subtest III Grammar (10) | 10.80 | 15.50 | 12.80 | 12.77 | 11.35 | 9.91 | 8.50*** |

*** $p < .001$

[a]Mean scores joined by a solid line differ significantly from one another

Mean scores joined by a broken line do not differ significantly from one another

[b]Maximum scores are indicated in parentheses

Appendix

Explanation of Analysis of Covariance

Analysis of covariance is a statistical procedure which is similar to the analysis of variance in that it is used to compare the results of two or more groups on a particular test. At the same time, analysis of covariance mathematically reduces the influence that another variable, such as I.Q., might have on the test results. For example, if two hypothetical language groups under investigation differ *a priori* in terms of I.Q., and if it is believed that I.Q., will significantly influence performance on the test being administered (e.g., a reading test), then an analysis of covariance will estimate the significance of the language factor. This mathematical procedure is used when it is difficult or impossible to select groups which are equivalent in I.Q..